Projects and innovation : the ambiguity of the literature and its implications

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Abstract

The strategic role of new product development and innovation (Nonaka & Takeuchi, 1986; Wheelwright & Clark, 1992; Hamel & Prahalad, 1995; Brown & Eisenhardt, 1998) makes design performance a central concern of managers. Project management therefore appears to be an adequate solution to the integration problems raised by these activities. Work such as that of Clark & Fujimoto (1991) has helped make heavyweight project management a dominant organizational model. In this article, we wish to question this tendency to equate projects and innovation. This tendency can, in fact, appear surprising inasmuch as Clark & Fujimoto (1991) indicate that their research does not take into account the question of advanced engineering or basic research. We therefore believe that it can lead to improper use of the project format to manage innovation. We feel that, in line with work on project classification (Wheelwright & Clark, 1992; Shenhar & Dvir, 1996, Balanchandra & Friar, 1997), a distinction should be drawn between the various design situations to which different types of projects will be suited. Qualitative research conducted at a European automobile manufacturer on Telematics services will allow us to identify the management methods suited to the most innovative projects, i.e. those for which neither technologies nor customer requirements are known at the start of the project (referred to by Atkinson & al. 2006 as “soft” projects) We will show how these situations shake up traditional project management models and will propose five management principles adapted to this new situation.

Projects and Innovation : the ambiguity of the literature and its implications.

The strategic role of new product development and innovation (Nonaka & Takeuchi, 1986; Wheelwright & Clark, 1992; Hamel & Prahalad, 1994; Brown & Eisenhardt, 1998) makes design performance a central concern of managers. Project management therefore appears to be an adequate solution to the integration problems raised by these activities. Work such as that of Clark & Fujimoto (1991) has helped make heavyweight project management a dominant organizational model[1]. Adler (1989), for example, makes the project the main way to implement innovations. This is a major characteristic of American managerial literature. Paradoxically, the leading US manuals (typically Burgelman et al., 2004) cover in detail the way in which the innovation process is carried out, technology analysis tools, the development of industry, etc., but offer little insight into the organization appropriate to innovation. Indeed, this topic is approached either via the resource-based model (Hamel & Prahalad, 1994), from the perspective of functional policies or, when the question of integration is raised, via project management models. The article by Clark & Wheelwright (1992) on heavyweight project management is therefore <u>the</u> incontrovertible reference.

In this article, we wish to question this tendency to equate projects and innovation. This tendency can, in fact, appear surprising inasmuch as Clark & Fujimoto (1991) indicate that their research does not take into account the question of advanced engineering or basic research (p. 26). We therefore believe that it can lead to improper use of the project format to manage innovation. We feel that, in line with work on project classification (Wheelwright & Clark, 1992; Shenhar & Dvir, 1996, Balanchandra & Friar, 1997), a distinction should be drawn between the various design situations to which different types of projects will be suited.

Qualitative research (Eisenhardt, 1989) conducted at a European automobile manufacturer will allow us to identify the management methods suited to the most innovative projects, i.e. those for which neither technologies nor customer requirements are known at the start of the project (referred to by Atkinson & al. 2006 as “soft” projects). We will show how these situations shake up traditional project management models and will propose management principles adapted to this new situation.

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[1] Although Eisenhardt & Tabrizi (1995) demonstrated the need to alter it in contexts marked by a high degree of uncertainty.

1. Projects and innovation: an analysis of the literature

1.1. The mutual ignorance between projects and innovation literatures

The links between project management and innovation management literatures are complex and are marked by a relative mutual ignorance.

On one hand, their is a tendency in the project management literature to equate project and innovative organization. Thus Cleland & Ireland (2002) recommend project management « *to any ad hoc undertaking* » (p. 69) and state that "*the justification for project management arises from the need for new or improved products, services or organizational processes*" (ibid.). They then propose criteria for assessing the need to resort to a project and recommend its use for innovation situations. However, their reasoning stops there while the "newness" of the situation relates, as we will see, to very diverse situations.

This tendency to equate projects and innovation has probably historical roots. Indeed, since its inception, project management has been associate with major innovations, specially in weapons systems design. Thus, in his seminal paper, Gaddis (1959) explains that project management is the best way to increase new product development efficiency in high-technology industries (electronics, defence, aeronautics, …). The Manhattan (Smyth, 1945 ; Groves, 1992 ; Rhodes, 1986), Polaris (Sapolski, 1972) and Appolo (Brooks & al, 1979; Morris, 1997) Projects have thus come to symbolize the effectiveness of project to manage extremely complex and innovative ventures.

On the other hand the literature on innovation management keeps up complex relations with projects. Organization by projects is rarely mentioned, even if this modes of management is frequently underliying. Thus, the project format is typical of "organic" operation, although Burns & Stalker (1961) make no reference to it[2]. In the same line, Van de Ven & al. (1999) never mentions it, although the situations studied often correspond to a project-based organization. Moreover, the principles proposed in his 1986 paper (*Self-organizing autonomous unit, redundant functions, requisite variety, temporal linkage*) clearly correspond to project management. This format therefore

[2] And for good reasons : Burns a Stalker are sociologist and, in 1961, project management is a rather fuzzy field.

seems, at first sight, to be the organizational model suited to innovation management. Furthermore this is emphasized by Mintzberg & McHugh (1985) when they equate project structure and adhocracy[3], explaining this is the most suitable way to manage innovation in organizations.

The link between projects and innovation is established by research on the key success factors of innovation to establish a link between projects and innovation. Maidique & Zirger (1990) plays here a pivotal role. they show that managerial excellence, defined explicitly as effective project management, is the main reason for successful innovations. Indeed they explain that

> « *Products are more likely to be successfull if they are planned and implemented well. Project planning should include all phases of the development process : research development, engineering, manufacturing and market introduction. The functional groups should interact and coordinate activities during the development process. Particularly important are the links between R&D and the other functional groups, marketing and manufacturing. One critical reason for a strong link with marketing is to ensure the firm understands user needs and effectively translate these needs into solutions for customers. The connection with manufacturing is emphasized because of the increasing importance of efficient and effective product operations, a goal that cannot be reached unless design for manufacturing is part of the product's development objectives.* » (1990, p. 879-880).

But their analysis of project management practices stops here, and they quote Nonaka & Takeuchi (1986) has examples of best practices in the management of innovative projects.

1.2. The emergence of a dominant model

The link between projects and innovation is thus brought to the fore by the study of Japanese firms which, in the 80's, are increasingly successful on the US and European markets. The works from Imaï, Nonaka & Takeuchi (1985), Nonaka & Takeuchi (1986), Clark, Chew & Fujimoto (1987) et Clark & Fujimoto (1991) enables to formalize a model of project management, referred here to as the *Heavyweight Model*, that will be considered as a panacea to manage new product development.

[3] « *One important contemporary form is project structure or adhocracy*". (p. 160).

In our view, *Product Development Performance* (1991) constitutes a landmark contribution to the literature on product design and project management[4]. Clark and Fujimoto started with performance data that showed the superiority of Japanese firms. They went on to present a detailed comparative analysis of product development practices at automakers around the world. Their contribution is twofold.

Conceptually, the authors regarded new product development as a set of *information processing and problem solving activities*[5]. The intermediate outputs of the process were *information assets*, in particular, product-specific knowledge and product and process designs. The aim of the overall process was to ensure the product's *integrity*, i.e. its intrinsic qualities and its ability to meet the customer's expectations. For a complex product like an automobile, the greatest management challenge was to establish organizational structures and practices that ensured adequate *integration* of diverse skills and knowledge, including the customers' knowledge about what it was like to use the product (Clark and Fujimoto, 1991, Chapter 2). This illustrates the structural convergence between the project mode of organizing and the challenge raised by innovation. Researches on innovation management thus underlines

- The crucial role of *integration* of the expertise necessary to the success of innovation (e.g. Gaddis, 1959 ; Lawrence & Lorsch, 1967 ; or more recently Iansiti & Clark, 1994),
- The need for flexibility in order to adapt to the evolutions of the environment and the resulting feedbacks between the different phases of the process (Burns & Stalker, 1961 ; Kline & Rosenberg, 1986 ; Van de Ven, 1986).

This helps us to understand the attraction force of projects to manage innovations even if, as we will see, this *a priori* convergence may be dangerous.

On the operational side, *Product Development Performance* brought into focus three important new management ideas: (1) heavyweight project managers; (2) overlapping problem-solving cycles (also called concurrent engineering); and (3) the integration of customers and suppliers into product development activities.

Heavyweight project managers: "To the extent that product performance is more than just the sum of component performance or technical specifications," Clark and

[4] Indeed chapter 5 "Designing the car" of the best-seller *The Machine that Changed the World* relies heavily on the work from Clark, Chew & Fujimoto (1987)

[5] This perspective opened new territories for research on new product development (see the surveys by Brown and Eisenhardt, 1995 and Krishnan and Ulrich, 2001). For an overview of K. Clarks works see Lenfle & Baldwin (2007).

Fujimoto argued, "firms need to worry about integrity and thus integration" (p. 250). They defined two types of integration: (1) *internal integration,* which aimed to coordinate the various groups within a company; and (2) *external integration,* which aimed to coordinate the company with customers and suppliers. Clark and Fujimoto observed that, in their sample, the highest levels of external and internal integration were achieved (by Japanese firms) through having a "heavyweight product manager." This manager was committed to the project through its entirety; was empowered to make key decisions; and had the status, experience and resources to exert influence on both team members and senior managers.[6] At least in the auto industry, heavyweight project managers were a pre-requisite to success in product development.

Overlapping Problem-Solving Cycles (Concurrent Engineering): Clark and Fujimoto identified and advocated practices that are now the hallmark of concurrent engineering, specifically: (1) overlapping the stages of the product development process; and (2) "high-bandwidth" and "bilateral" communication between those involved in each stage. The aim of overlapping stages was to anticipate downstream problems and fix them early, thus shortening development time. Clark and Fujimoto argued that this practice could be effective only if the upstream and downstream participants communicated in real time from the beginning of the process. This in turn meant that the work of project participants would change significantly. To justify the increased costs of concurrent engineering, Clark and Fujimoto developed constructs to measure the overlap, intensity and effectiveness of interdepartmental communication. They combined these metrics into a single "integrated problem-solving index." They went on to show that Japanese firms generally had higher index scores, but, more importantly, that high scores were correlated with superior performance in terms of lead time, development productivity and product quality.

Co-development: a new role for customers and suppliers: By the late 1980s it was well known that Japanese firms were less vertically integrated and relied more heavily on their suppliers than their western counterparts. Clark and Fujimoto's contribution was to show how vertical relationships affected product development. In their view, the ideal state of "integration," which gave rise to product "integrity," did not stop at the boundaries of a firm, but extended backward to its suppliers and forward to its customers as well. *External integration* by definition took place across a firm's boundaries. The idea was to shorten overall development time and improve the quality

[6] On the origin of this so-called "shusa" system at Toyota in the 1950s see Fujimoto, (1999, pp. 73-74).

of the product by involving customers and suppliers in the early stages of product design (Clark, 1989). These practices allowed mutual adaptation of product and process designs to take place, which in turn led to improvements in product functionality, cost, quality, and delivery time[7].

1.3. Toward a contingency theory of project management

The work from Clark & Fujimoto seems very important because it exert a strong influence over the project management pratices of european and US firms (see Midler, 1993 ; Ellison & al. 1995 ; Fujimoto, 1999). It thus constitutes a model of « best practices » which rapidly becomes synonymous with efficiency in project and innovation management. This can, in fact, appear surprising inasmuch as Clark & Fujimoto (1991) indicate that their research does not take into account the question of advanced engineering or basic research (p. 26). Moreover in another book, Wheelwright & Clark (1992) emphasizes the need to distinguish between different types of project and to adapt the management methods and organization accordingly. This has been subsequently elaborated on by Shenhar & Dvir (1996 & 2004) and Shenhar (2001) among others, for technical projects. We believe, however, that the research of Shenhar has not fully taken into account the impact of innovation on project management methods. Thus, Shenhar & Dvir limit their approach to the technical and temporal aspects of innovation. They focus on the resources put in place to achieve an objective and not on the objective itself, which can also be uncertain. Following the work of Abernathy & Clark (1985) projects can therefore be classified based on their impact on the firm's technical capabilities and on its "market" capabilities. In this perspective, "Development" refers to a situation were the technical and market knowledge associated with the project are well-known, whereas "Innovation" refers to a situation were both have to be explored. We therefore agree with contemporary thinking on the management of innovation, defined as a two-fold process of exploration of knowledge and concepts[8] which then give rise to developments or research (Lenfle & Midler, 2003; Lenfle, 2004; Le Masson et al. 2006).

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[7] Clark and Fujimoto documented major differences, not only in the degree to which Japanese automaker were vertically separated, but also in the ways customers and suppliers participated in new product development. For example, U.S. firms used armslength contracts to manage suppliers and relied mostly on off-the-shelf parts for their new vehicles. In contrast, Japanese automakers brought their suppliers into the product development process and, as a result, had much higher percentages of newly designed parts in their new vehicles (Clark and Fujimoto, 1991, p.151, Figures 6-8).

[8] We refer here to the C/K theory of design developed par Hatchuel & Weil (see 2003 for an introduction).

The question thus becomes what is the impact of this definition of innovation on project management ? The central issue is therefore whether the project format is suited to the management of innovation. Research conducted at a European automobile manufacturer on telematic services (Lenfle & Midler, 2003; Lenfle, 2005) shows, in fact, that innovation seriously disturbs the development model which, as we have shown, is dominant in the literature. This type of design situation shows five characteristics that are problematic for project management. Before analyzing this characteristics, we present our methodology.

2. Research Design and data

To study these questions, in 2001 we made contact with one of the principal European car manufacturers, here identified as Telcar for reasons of confidentiality. After a presentation of our previous research on managing innovative projects (Lenfle & Midler, 2002), Telcar gave us permission to study the case of Telematic Services. Before describing our methodology for data collection in detail, we shall begin by providing an overview of this services.

2.1. Research Site

The New Information and Communication Technologies (NICTs) have for several years constituted a very fertile field for innovation with the proliferation of initiatives relating to telematics services for automobiles, or the “communicating car”. These terms refer to the motorist's ability to access, from the vehicle itself, a certain number of services, which are customarily grouped in four areas:

1. Emergency breakdown service: a localized call for breakdown service in the event of a problem, the automatic triggering of SOS assistance in case of an accident, and remote maintenance;
2. Navigational aids: navigation, plus guidance to amenities and points of interest (i.e. parking facilities, tourist attractions, hotels);
3. Communication services: telephone, sending/receiving of e-mail, videoconferencing and the like;
4. Entertainment or so-call “infotainment”: i.e. hotel reservations, online shopping, games for passengers, creation of a personal jukebox and so on.

Design and exploitation of such services involve various actors in complex cooperation processes. Service providers generate the information needed for the service (for example traffic information) and operate the service platform (for example the emergency call center) ; telecom operators develop and maintain the communication systems that connect the car to the service operators ; car equipment suppliers develop the onboard systems needed for the service (for example integrated radio, GPS and GSM equipment) ; car manufacturers specify, integrate and market the new services and onboard equipments.

The first commercially available application, Onstar, was launched by GM in 1996, and other manufacturers quickly followed suit: BMW with Passo (1997) and then Assist (2000), Renault with Odysline (1999), Ford with Wingcast (2000), Fiat with Connect (2000), and Mercedes with Tele Aid (2001). The outlook today appears uncertain and ambivalent. On the one hand, the massive projections put forward in 2003 have never been realized[9] and many OEM are experiencing great difficulties. Even the frontrunners count only several hundred subscribers (Fiat), while several projects were discontinued in 2001 (Renault's Odysline) or profoundly restructured (PSA Peugeot Citroen). On the other hand, GM – with its claim of 4 millions subscribers[10] – is the only manufacturer that has achieved a certain degree of success as far as concrete results are concerned; at the other end of the scale, European manufacturers are experiencing great difficulties. And looking beyond the distribution of these innovations, the strategic and financial benefits of injecting massive investment into this field of innovation remain very uncertain for manufacturers.

2.2. Data collection and analysis

Data collection was performed over a three-year period. This enabled us to take part in the real-time design process and in the marketing of the first telematic service (emergency and breakdown call launched in February 2003)[11]. Consequently, we were able to follow and analyze the whole design process, and then observe its results. To do this, we received support from the Project Manager as well as from its main sponsors. As a result, we had virtually unlimited access in the field. The duration and frequency of

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[9] For example the Frost & Sullivan firm has evaluated the market for automotive telematics services at 8.5 billion euros in 2007 and predicts a 15% growth rate beginning in 2003.
[10] Source : www.OnStar.com, Press Room, accessed june 25, 2007. See also Christensen & Roth (2002).
[11] See Lenfle & Midler, 2006.

the interaction with the design team enabled us to follow the development of the design process accurately and gain access to data sources usually closed to outsiders. More specifically we relied on three sources of evidence:

1. About 70 semistructured interviews were conducted with 30 participants in the project. These interviews involved both technical infrastructure managers and the teams in charge of marketing and sales.
2. We passively participated in all relevant meetings on the design of the Telematics services. In particular the monthly plenary meeting at which the progress of the project was discussed ;
3. Written documents supplied by the company (reports, minutes of meetings, PowerPoint presentations, and so on), which enabled us to reconstruct the history of the project and its organization, to prepare for interviews and to obtain corroboration of interviewees' statements;

Following the paradigm of grounded research (Miles & Huberman, 1984; Eisenhardt, 1989; Yin, 2003) our analysis was built on detailed field notes – interview notes, transcripts of project meetings, company documents – compiled into detailed case studies for each phase of the design process. This process was iterative as the cases were frequently updated after follow-up discussions with respondents. More precisely each case study report was re-read by key informants and discussed during bi-annual research meetings involving the project manager and members of the project steering committee. These meetings simultaneously enabled the results presented to be confirmed and the directions taken by the research to be discussed.

3. The impact of innovation on projects : the destabilization of development

This research allows us to analyze the gap between development and innovation situation. This leads us to study the adaptation of project management to the latter. More precisely we have identified five characteristics of "innovative projects" that destabilize the "Development" model.

3.1. Emerging, strategically ambiguous projects (C1)

In development projects, the strategy is formulated prior to the project's implementation. In innovation projects, such prior definition of a strategy is difficult, simply because there is no shared understanding of the phenomena and causalities needed to formulate a strategy. What are, for example, the uses of "hydroforming" (Lenfle, 2001) ? What is a telematic service (Lenfle & Midler, 2003b)? How does one define an "autonomous flying vehicle" (Holmberg et al., 2003)? Here it is clear that it is impossible to first define the strategy and then begin the project. On the contrary, the project will make it possible to gradually define the strategy (Burgelman, 1983).

This characteristic can be problematical, since it can be a source of confusion and misunderstanding over the objectives pursued by the various participants in the project. Two different strategic outlooks underlie current initiatives in the area of telematics services:

- The first continues the innovation strategies that have been known to drive the automobile market for a decade (e.g. Clark & Fujimoto, 1991; Midler, 1996): the aim is to provide a distinguishing "value-added feature". Service innovations, with their attendant technical equipment, are only an additional developmental stage, in the tradition of the airbag, ABS, the keyless car etc.
- In the second strategic vision, the key element for manufacturers is the effectiveness of the commercial relationship between the company and its customer (which can be measured by customer loyalty rates, marketing costs and so on), an area that up until now has been relatively untouched by the waves of rationalization undergone by the automotive industry. In fact, it has been shown (Winer, 2001) that the automotive sector is one of the segments in which it is very difficult to set up a lasting customer relationship, due, first of all, to the infrequent nature of transactions (one buys a car only rarely) and, secondly, to the presence of an intermediary that acts as the interface between the customer and the manufacturer. In this context, the communicating car becomes a means of establishing a richer and more continuous relationship with customers by offering them services that set up a direct relationship with them beyond the act of purchasing the vehicle.

In principle these two strategic outlooks appear very similar and entirely compatible : the car manufacturer can launch an innovative equipment that simultaneously support new services used to improve his CRM strategy. But in fact, the two strategies implies different priorities for the project teams :

- Thus, the speed with which the conspicuous onboard equipment in a car can be put on the market is a key point for the first viewpoint while, in the second outlook, redefining the customer-brand relationship is emphasized, which presupposes the setting up of an entire infrastructure for the use of the information within a CRM context.
- Similarly, there are differing economic equations associated with the two strategies: the first strategy is based on a traditional economic argument, given the context of selling innovative equipment; in the second viewpoint, the economic repercussions are more indirect, but also more lasting (i.e. increased return on selling costs or improved customer loyalty).

The story of the Telematic project show that the blocks and changes leads the team to study different scenarios which helps to progressively define the strategic goals pursued.

3.2. A proactive approach (C2)

The second difficulty lies in the fact that there is no explicit demand on the part of customers, and therefore no clearly identified market. This raises two problems. The first one refers to the legitimacy of the project in the organization. As shown for example by Dougherty & Hardy (1996) or Christensen (1997) innovative projects frequently suffer from their inability to secure the needed resources because of their illegitimacy regarding the dominant logic of the firm. Secondly this raise the question of the target audience (Who are the customers? What do they want?)

The problems currently being encountered can be summed up by two major difficulties:

- <u>Defining the innovative service</u> – The list of possible services is potentially quite large, ranging from traditional roadside assistance to hotel reservations, traffic information and e-mail services. The concrete implementation of these services offers the opportunity for a variety of solutions, between which it is difficult to choose. This is complicated by the fact that Telematics Services are completely new both to the public and the company.
- <u>Assigning a value to the innovative service</u> – This is primarily a problem that stems from the fact that customers “do not know what they are buying” and,

with the exception of a few technology buffs, they are not willing to pay extra for it. But the problem also stems from the fact that the economic models for these services are new for the automobile industry: subscriptions, pay-per use, the involvement of third-party financing and so on. There is a great deal of uncertainty surrounding the costs associated with these services since they involve lasting commitments to processes that depend on a high level of customer initiative, which cannot be easily controlled. This can result in situations that might appear paradoxical, where certain services are launched for their image value alone with the hope that they *don't* “take off”, because a deficit would result from their full deployment.

3.3. The difficulty in specifying the result of the projects (C3)

This absence of clearly identified customers challenge one of the basics of project management : the existence of a clearly defined objective. Moreover, divergence can be conceived as a structural characteristics of innovation (Van de Ven, 1989 & 1999). Therefore the result of the project therefore becomes difficult to define and the revenue indicator only very partially reflects the issues related to the project’s progress. Specifically, the goal cannot only be to develop a product whose characteristics are relatively clearly defined beforehand. Launching a service is not an end in itself for this kind of project. Rather, the goal should be to develop concepts and to creates knowledge that can be quickly applied to the design of other applications. Without this perspective, the investments required would not be profitable. As a result the total sales figure gives only a very incomplete picture of the project’s achievements. This raise an important question. Indeed, it is well known that clear perception of the potential gain from projects, undertaken with a view to actual production of the product at a given date and with given resources, is a powerful motor for energizing development projects. However, management of innovative projects cannot count on this mechanism due to the relatively abstract and diffuse character of the results and the stakes involved.

Nevertheless recent advances in the theory of design helps us to clarify the “results” of this kind of projects. Following here Le Masson, Weil & Hatchuel (2006), we can identify Four different results for this projects :

1. Concepts that, after development, becomes commercial products
2. Concepts that have been explored but adjourned due to lack of time or resources

3. New knowledge that has been used during the exploration and can be re-used on other products (e.g. components, technical solutions, new uses, and so on)
4. New knowledge that has not been used during the exploration but can be useful for other products.

More than an absence of clearly defined objective, we shall therefore talk about a new type of objective[12].

3.4. Exploration of new knowledge (C4)

Innovation projects make use of a technical innovation, a new practice, a new business model, etc. which, by definition, are not stabilized. As a result, the team will need to explore and develop new knowledge, which adds great uncertainty to the process. This high level of uncertainty has two consequences:

First, there is a much lower probability that such innovation will ultimately find their way to the market. This explains the culture of caution that has taken root in this situation. Given the lower likelihood of success, firms hesitate before undertaking more extensive research, which, if unsuccessful, will be a lost investment. This culture makes it difficult to implement the principle of anticipation so important in modern project management. This has all too familiar consequences, such as projects that spiral on and on; although they do not immediately use many resources, no-one knows whether they will eventually produce any results. Just how far is the principle of anticipation applicable, and how is it possible to break this vicious circle in which the likelihood of success remains low because no-one dares to anticipate?

Second, Unlike development projects where the result is the attainment of an objective, the knowledge management dimension is therefore ever-present and entails exploring an the innovation field as quickly and as effectively as possible. In this context, the marketing of a product/service must be viewed as a clue to the identification of the initially unknown innovation field. The effectiveness of

[12] We can actually wonder if the existence of a *clearly defined* objective is not overemphasized by the literature on project management. Consider the extreme case of the Manhattan Project that lead to the Atomic Bomb. At first sight the goal is clearly defined : build an atomic bomb (and this is identified by General Groves, the project manager, as a key success factor; Groves, 1962, p. 414). But in fact reports on the Manhattan Project (e.g. Smyth, 1945; Groves, 1962 ; Rhodes, 1986) showed the extraordinary uncertainties the project has to manage throughout its duration. Neither the technology (product and process) nor the “concept” where actually clearly defined (see the reactions to the Trinity Test on july 16, 1945 in Rhodes, 1986) and the team manage simultaneously the most fundamental research and product and process engineering. What seems to us important is thus less the “clarity” of the objective than the fact that the team was entirely dedicated to the venture.

management is therefore equivalent to the effectiveness of a learning/knowledge creation process, which is a step beyond development.

This uncertainty change radically the unfolding of the design process. Indeed, Project management for products has been structured in such a way as to uncouple the elimination of major uncertainties (i.e. the role of advanced engineering) from Development. Our prior comments make it clear that this uncoupling is particularly problematical in the development of telematics services, where it would seem, on the contrary, that product development and the establishment of an upstream knowledge base cannot be separated. Indeed when dealing with innovative applications, the marketing of new products or services is a prerequisite to the creation of expertise, which must be based on the way these services are received and accepted by customers. Moreover, with the uncontrollable proliferation of technology providers, experimentation is unavoidable, even at the risk of a high probability of failure. It then becomes necessary to make the best of such failures by capitalizing effectively on the lessons they provide.

3.5. A specific temporality: hidden urgency and a multiplicity of time horizons (C5)

The development of a new product within the framework of development projects is a process driven by milestones and limited by commercial necessity. In the 90's the implementation of heavyweight project management has played a crucial role to make time-to-market the central rhythm of the firm and its suppliers (Midler, 1993 ; Fujimoto, 1999). Urgency is built-in and is a powerful tool for motivating those involved (Gersick, 1988; Brown & Eisenhardt, 1997). For an innovation project, the situation is characterized by the concept of "hidden urgency". The innovation developed must be integrated into the development projects. However, the window of opportunity for achieving this is very narrow (one year during advanced development in the auto case, see Lenfle, 2001). Moreover, the team cannot limit its horizon to a single project. The fact that the various processes overlap therefore makes the deadlines difficult to discern. One will need to decide which project to focus on in the short term in order to introduce the first version of the products/services developed, while at the same time being mindful of the other aspects that need to be explored, an exploration that relates to subsequent projects and/or research initiatives.

4. How to manage innovative projects ? The Telematic Platform as a prototype organization.

What kind of organization would be capable of driving the exploration of such an innovative field ? The Heawyweight Model would appear to be ineffective, since it is no longer possible to specify in advance either the objectives to be attained or the course the project should take. Some recent researches suggests guidelines for more appropriate tools.

- The “lineages” concept (Chapek, 1997 ; Le Masson, 2001) emphasize the dynamic structuring of repeated product innovation strategies and of learning curves regarding technical and functional concepts and fields of knowledge, but leave wide open the question of how these should be transformed into organizational and interfirm cooperation tools.
- The “experiential model” of product development formalized by Eisenhardt & Tabrizi (1995) is based on the analyze of product development pratices in the highly-dynamic computer industry. It underlines the role of intensive experimentation, rapid iterations, frequent milestones and powerful project leaders.
- “Innovative project management” was defined and tested in our previous research (Lenfle, 2001) to fill this gap. We formalized generic principles to manage this highly risky projects (ibid.), and the Telcar Research, gives us the opportunity to test the relevance of these generic principles. We used it to analyze the organizatioin set up by Telcar to manage an ambitious innovation-based strategy in the field of telematics.

In this part, we shall detail the results of this analysis, which focuses on one specific case, the telematics platform (TP). After presenting this organization, we will show that the management of such projects implies the development of specific management principles.

4.1. The Telematic Platform

Between 1998 and 2004, TelCar decided to set up a dedicated structure to organize the development and marketing of telematics services. The TP has brought together, in the same location, a team of approximately twenty people representing different department of the firm (marketing, IT, electronics, purchasing, product line management, services etc.). The TP has its own budget and operates under a single manager. This platform has a multi-faceted mission:

- it is charged with maintaining a technology watch over Telematics,
- it is responsible for defining specifications for future telematics hardware and services, anticipating problems concerning the building of equipment into vehicles, and even identifying suppliers that are likely to participate in this field.
- Finally, it must coordinate initial implementation of the first services.

In the following sections, we describe and we analyze the running of the TP in the light of our theoretical framework. Indeed we have identified five principles that summarized the functioning of the TP and provides the basis of a project management model adapted to innovation.

4.2. Management principles

4.2.1. Develop a specific evaluation reference

The first difficulty faced by innovation projects is that of legitimacy. Given their nature, one of the major risks is to view them as a multitude of studies conducted independently by various entities of the organization (business lines, projects, hierarchies) and/or of its partners, and not to regard them as a coherent unit with significant implications. ***Our first principle therefore affirms the need to develop a specific evaluation reference.*** Formalization of an innovation project therefore results in an indivisible group of studies that concern a technique and its applications being accepted as a unit of action in order to gradually create overall competence in the field (uses, technical solution, partners, etc.). The difficulty then is to manage this portfolio, in which each study is carried out not only for its own sake but also for its contribution to the whole.

The setting up of the TP conforms to this vision. The existence of this organization within TelCar provided the conditions for an innovative exploration in a field that essentially cuts across all boundaries – those of projects, skills, products, time constraints, and functional departments. It takes into account the interdependence of the various dimensions of the Telematics services. However, at the same time as it plays out its commando role in an emerging field, this type of set-up must work with existing entities, which will subsequently use and build upon what has been learned. The TP was in a position to cooperate with other parts of the company, which leads us to look at the various existing means of cooperation with other parts of the organization (technical departments, commercial structures, and so on). In the TP's case, there was an "outer circle" made up of representatives of technical departments and product lines. Members of this group were heavily involved in the subject while still remaining attached to their original departments: they were often at the platform and participates to the "Telematic plenary", the monthly meeting organized by the TP manager to check-up the course of the project. Also included were management structures set up by the manufacturer to handle all questions connected with telematics. These structures usually draw in participants from a more senior level in the hierarchy, although for the most part on a strictly part-time basis. The members of the "outer circle" have a dual role, which is essential since they constitute a key link in the "attachment" of the platform to the company. On the one hand, they are the representatives of the product lines and the technical departments within the platform. Wearing this hat, they complement the skills brought together in the inner circle by supplying the expertise of their own departments. Their contribution also includes clarifying the policies and constraints that must be built into the platform for its actions to be acceptable to the rest of the company. On the other hand, they are the representatives and channels of communication from the platform to the technical departments and product lines, and thus participate in disseminating the TP's activities within their own spheres[13].

While it clearly illustrates the first principle of a unifying organizational identity focused on a single concept, our analysis of the TP also reveals how difficult it is to preserve a balance between focusing on the emerging concept and maintaining cooperation among the various elements present. Our research in fact showed that:

- As far as bringing together the various initiatives was concerned, the TP could hardly be said to have drawn in certain strands initiated prior to its creation;
- As far as the involvement of key skills was concerned, the fields of services and distribution were underrepresented compared with technical skills.

4.2.2. The central role of experimentation and concurrent exploration

The uncertainty inherent in these projects constitutes the second difficulty faced by the team. The traditional methods of project management are in part ineffective: no

[13] A classical "core team members responsibility" (Clark & Wheelwright, 1992).

project schedule, difficult task breakdown, constantly changing objectives, etc. This then raises two questions:

- What to do in this type of situation where everything is uncertain and where it is difficult, and even impossible, to anticipate problems based on past experience?
- Where to begin? Is it necessary to explore phenomena and functionalities separately or at the same time?

On the first point, studies on innovation and design management (Van de Ven, 1989 & 1999; Lynn et al., 1996; Brown & Eisenhardt, 1997; Thomke, 2003) underscore the need for action (*Bias for action*) in the absence of clear preferences, which will allow problems and solutions to be discovered. ***Our second principle therefore emphasizes the central role of tests (prototypes, testing, customer trials, etc.) in the management process[14]***.

Sketching out a plan of action must therefore be seen as a temporary grid over the field to be explored, allowing the learning process to begin. In this context, the design of the experiments that will prove or disprove the initial hypotheses occupies a crucial place in the management of the project. This is a key coordination element, inasmuch as no other timescale is applicable, unlike with development projects. In addition, it is a way of creating knowledge (and surprises!) that could radically change the direction of the investigation, whereas in development projects the main purpose of testing is to confirm the validity of the proposed solutions. The intensity of the learning experience will depend on the ability of the team to generate, carry out, and learn from a continuous flow of tests over a period of time (Van de Van & al. 1999; Iansiti, 1998; Thomke, 2003). And, indeed, the history of the TP is littered with such experiments, which, while using relatively modest means, enable testing of the projected services (prototypes on test rigs, experimentation using simplified versions of the services to be provided based on temporary agreements with various partners etc.).

The second point relates to the way in which these projects are carried out. In an extremely dynamic context, separating technical and market explorations increases the

[14] In this respect, we agree with the "experiential" model proposed by Eisenhardt & Tabrizi (1995), which stresses the importance of the frequency of tests and milestones to coordinate design activities in a situation of great uncertainty.

risk that an answer that is relevant at a given time is no longer relevant when the other dimensions of the problem have been resolved; consequently, the project is constantly drifting.. ***The third principle therefore emphasizes the need for concurrent exploration,*** which must concern both concepts and knowledge. This being the case, whether the project comes to fruition or not depends on the speed of the investigation and on the synchronization of a solution in the area of marketing and technology. In accordance with this principle, an investigation strategy where all the studies are scheduled to run in parallel would be of much greater value than an investigation where they are scheduled consecutively. This corresponds to the idea of concurrent engineering; however, the objective is not so much the speed of the market launch as the increased likelihood of success. There is therefore a shift from concurrent engineering to concurrent exploration (Gastaldi & Midler, 2005).

That is why the TP's mission covers everything from exploring the field to lauching new services. It is in fact now well established that the validation of the first ideas to be developed plays an essential role in the design of innovative solutions [3] & [5]. In any case, the role of the platform will evolve from phase to phase :

- The platform assumes the leadership role in the initial stages, which consist of:
    - *Exploring* the field of innovation "defined" by the driving concept of a "telematics service" (What services are possible? What technical lines of attack can be envisaged?);
    - *Sorting out* which of these strands fit in best with the company's overall strategy. Here, the role of the tool is to prepare and organize the decision-making paradigm of the sorting process, which should be confirmed by company management representatives (technical, production and marketing departments etc.);
    - *Preparing the solution* (once the concepts have been defined), by designing “halfway solutions” [10] that correspond to potential applications and have been through a validation process proving them suitable to be put forward as a credible proposal to the project teams.
- The leadership role then passes to the technical groups and project teams for the final development stage, although the platform continues to monitor the implementation in order to prepare future services. This is in fact the time when problems with implementing the concept are discovered, factors that will enable subsequent versions to be improved.

The major difficulty here is to strike a balance between these two roles. Two kinds of drift are in fact possible:

- *The first is a drift towards pure "research".* In this case, the platform comes to be seen as a technology-watch tool, relatively isolated from the development stage. However contact with the practical side is crucial for the improvement of successive generations of applications. The platform's own experience has shown how difficult it is to draw in the technical people if the solutions that have been developed are not sufficiently "mature" or "tried and tested".
- *Conversely, the project can veer towards the development side* by taking over the whole process of perfecting both services and equipment instead of leaving this to the traditional development projects. This problem was clearly observed on the TP, which, having noticed how technical uncertainties had plagued the vehicle project teams, took over the development of onboard hardware intended to handle future telematics services. The extent and difficulty of this development task rapidly shifted the centre of gravity of the TP's activities from a "federating pre-project phase" position in the field of telematics services to the position of developing an individual product.

4.2.3. The dual nature of performance & reformulation of the goals along the way

The last difficulty relates to management of this type of project, given that it is not possible to organize the convergence toward a pre-defined objective. One must therefore assume that each test associates a knowledge production process with a revenue creation process. ***Our fourth principle states that the management process must take into account these two different dimensions of performance: the value of the products and accumulated knowledge.*** This two-tiered dimension of project performance is very present in Clark's work (particularly Iansiti & Clark, 1994). However, it is still treated as a by-product of development. Use of this knowledge is a matter that is often left to the project's audit team (Wheelwright & Clark, 1992, chap. 11). We feel, however, that this issue is at the heart of innovation project management, *while the project is being carried out.* It is one of the advantages of defining the project as a reference unit, where the team is explicitly responsible for this knowledge management among the various experiments and horizons it manages. It will then facilitate the creation of "learning income" (Le Masson et al., 2006).

A management tool must therefore take these two aspects of performance into account (see rows and columns of Fig. 1). A study can therefore progress to the marketing stage without providing any new knowledge apart from the fact that there is an immediate market for the component in question. Conversely, another study might not go on to produce any revenue but may nonetheless generate crucial knowledge for understanding the technique or for defining its potential field of application. This kind of management is essential in emerging technology, where the risk of failure is great because of the one-off nature of the strategy. The way the TP is defined accords with this philosophy of integrating a diversity of experiments in the strategy of investigating the field comprehensively. This strategy will enable progressive specification of the objectives to be reached (see rows and columns of the following diagram).

Figure 1: The dual nature of the performance of studies in the portfolio of an innovative project

Studies	**Customer's sector**	**Service definition**	**Technical options**	**Etc.**	**Outcome**
Study 1					**Result of studies**
Study 2					
…					
Study n					
Outcome	**Knowledge drawn from studies that can be used elsewhere**				

Similarly, the management tools used must allow a reformulation of the objectives along the way (fifth principle). Projects will then be very heuristic, in which one can explore the space of potential targets and answers simultaneously, in search of satisfactory concept/knowledge combinations. The focus here is on gradually structuring the area explored. Performance is therefore judged according to the *increasing return of the iterations*_(Lenfle, 2001 ; Lenfle & Midler, 2002). To start with, investigations are guided by a set of requirements that may be the evaluation of a specific technology or, on the other hand, the fulfilment of a potential customer's need. The process of seeking an answer will generate knowledge that may well call into question the relevance of the original question or requirements. An investigation is not a simple tracing of the route from a single question to a single answer; it is the exploration of a matched question-and-answer pair, which may change as time goes on. The knowledge accumulated at time T makes it possible to better define the objectives and constraints for period T+1: the technical areas to be explored are clarified, certain functionalities are excluded while others emerge, the right partners are identified, and so on. Thus, bit-by-bit, the investigations converge, or stop if the technique proves to be less useful than was previously thought.

An illustration of this situation is provided by the history of telematics within TelCar. The strategy of the company in this area became progressively clearer between the two underlying visions that we identified in the first part. The slump in the value of dot-com companies also had a profound effect on the hypotheses and the conditions that had enabled the first operational steps to be taken. This Telcar has progressively abandoned “infotainment services” to re-focus on “Automotive telematics” (emergency and breakdown call, traffic information, navigational aids, …).

5. Conclusion

Our analysis shows that the *a priori* convergence between projects and innovation can be misleading. Following the growing body of research on the contingency theory of project management (Wheelwright & Clark, 1992; Shenhar, 2001; Shenhar & Dvir, 2004), we emphasize the need to distinguish different situations and, accordingly different way of managing project. Specifically we demonstrate that organizations that have performed well in the efficient development of innovative products are ill equipped to grasp the opportunities in fields where both technical solutions and uses are highly uncertain.

The Telematics Platform tried out at TelCar constitutes an organizational prototype, which broadly confirms the theoretical model of the project management of “innovative project” that we have described in another context (Lenfle, 2001). It illustrates the need to set-up a dedicated structure to manage the exploration of a “field of innovation” (Le Masson, 2001) that cut across traditional firm boundaries (department, project, time constraints…). But, at the same time, our research reveals some weaknesses. Firstly we explain the difficulty to involve the different departments concerned by the innovation (especially the sales networks, see Lenfle & Midler, 2006) or to take in projects initiated before the creation of the TP. Secondly, we show that the TP drift toward pure development, partly because of problems with a supplier and partly because of the reluctance of project teams to support highly uncertain developments. Finally we propose five principles that form the outline of a project management model suited to the most complex innovation situations. They help

- define the nature of the desired objective (product and knowledge, gradual structuring of the innovation field).
- discuss the nature of organizational settings suited to these situations.

We therefore hope to contribute to the development of less tangible, but more generic management processes associated with highly uncertain environments, thus extending the scope of project management (Atkinson & al. 2006).

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